

What is claimed is:

1. A motor control apparatus for controlling a voltage applied to an alternating current (AC) motor using a PWM signal, comprising:

magnetic position estimating means for detecting a current of said AC motor to estimate a magnetic pole position of said AC motor; and

fault detecting means for detecting a fault in an estimated magnetic pole position of said AC motor.

2. A motor control apparatus according to claim 1, wherein:

said fault detecting means includes means for calculating instantaneous power by multiplying a current value by a voltage value of each phase of said AC motor, such that said fault detecting means detects inversion of an estimated magnetic pole position by comparing the instantaneous power with power determined from a torque command and a rotational speed of said AC motor.

3. A motor control apparatus according to claim 1, wherein:

said fault detecting means includes means for detecting an input voltage and an input DC current from a direct current (DC) power supply, such that said fault detecting means detects inversion of an estimated magnetic pole position by comparing power of said DC power supply with power determined from a torque command and a rotational speed of said AC motor.

4. A motor control apparatus according to claim 1,  
wherein:

said fault detecting means includes means for  
detecting an input DC current from DC power supply, such  
that said fault detecting means detects inversion of an  
estimated magnetic pole position by comparing the sign of  
the DC current with power determined from a torque command  
and a rotational speed of said AC motor.

5. A motor control apparatus according to claim 1,  
wherein:

said magnetic pole position estimating means  
applies an AC pulse voltage signal in a d-axis direction on  
a rotating coordinate system of said AC motor to estimate a  
magnetic pole position of said AC motor from a difference  
between a current generated when the AC pulse voltage signal  
is applied in a positive direction and a current generated  
when the AC pulse voltage signal is applied in a negative  
direction; and

said fault detecting means detects inversion of an  
estimated magnetic pole position from a phase difference  
between a voltage command vector and the d-axis on the  
rotating coordinate system recognized by said control  
apparatus.

6. A motor control apparatus according to claim 1,  
wherein:

said magnetic pole position estimating means  
applies an AC pulse voltage signal in a d-axis direction on

a rotating coordinate system of said AC motor to estimate a magnetic pole position of said AC motor from a difference between a current generated when the AC pulse voltage signal is applied in a positive direction and a current generated when the AC pulse voltage signal is applied in a negative direction; and

said fault detecting means detects inversion of an estimated magnetic pole position by comparing a voltage command vector on the q-axis on the rotating coordinate system with a rotating direction of said AC motor.

7. A motor control apparatus according to claim 1,  
wherein:

said magnetic pole position estimating means applies an AC pulse voltage signal in a d-axis direction on a rotating coordinate system of said AC motor to estimate a magnetic pole position of said AC motor from a difference between a current generated when the AC pulse voltage signal is applied in a positive direction and a current generated when the AC pulse voltage signal is applied in a negative direction; and

said fault detecting means detects inversion of an estimated magnetic pole position and out-of-synchronism by monitoring a current difference value on the d-axis on the rotational coordinate system.

8. A motor control apparatus according to claim 1,  
wherein:

said magnetic pole position estimating means applies an AC pulse voltage signal in a d-axis direction on

a rotating coordinate system of said AC motor to estimate a magnetic pole position of said AC motor from a difference between a current generated when the AC pulse voltage signal is applied in a positive direction and a current generated when the AC pulse voltage signal is applied in a negative direction; and

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said fault detecting means detects inversion of an estimated magnetic pole position and out-of-synchronism by monitoring a difference between the current differences on the d-axis on the rotating coordinate system.

9. A motor control apparatus according to claim 1,

wherein:

said fault detecting means detects oscillation, inversion and so on of an estimated magnetic pole position when a changing rate of the estimated magnetic pole position exceeds a predetermined set value.

10. A motor control apparatus according to claim 1,

wherein:

said fault detecting means includes rotational speed calculating means for calculating a rotational speed of said AC motor, such that said fault detecting means detecting oscillation, inversion and so on of an estimated magnetic pole position when a calculated rotational speed exceeds a predetermined set value.

11. A motor control apparatus according to claim 1,

wherein:

said fault detecting means includes rotational

speed calculating means for calculating a rotational speed of said AC motor, such that said fault detecting means detects oscillation, inversion and so on of an estimated magnetic pole position when a changing rate of a calculated rotational speed exceeds a predetermined set value.

12. A motor control apparatus according to claim 1,  
wherein:

    said magnetic pole position estimating means estimates a magnetic pole position of a rotor of said AC motor based on a current value of said AC motor detected in synchronism with a carrier of the PWM signal;

    said magnetic pole position estimating means includes:

        position calculating means for estimating a magnetic pole position direction of the rotor of said AC motor; and

        polarity discriminating means for discriminating whether said magnetic pole position direction derived from said position calculating means is in an N-pole direction or in an S-pole direction; and

    said fault detecting means determines a fault when said polarity discriminating means does not discriminate the magnetic pole position direction within a predetermined time period.

13. A motor control apparatus according to claim 1,  
wherein:

    said fault detecting means shuts down an associated system when said fault detecting means detects a

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fault, said fault including oscillation, inversion and so on of an estimated magnetic pole position.

14. A motor control apparatus according to claim 1,

wherein:

said polarity discriminating means again corrects the polarity to continue a control when said fault detecting means detects a fault, said fault including oscillation, inversion and so on of an estimated magnetic pole position.

15. An electric vehicle equipped with a motor control apparatus for controlling a voltage applied to an alternating current (AC) motor using a PWM signal, said motor control apparatus comprising:

magnetic position estimating means for detecting a current of said AC motor to estimate a magnetic pole position of said AC motor; and

fault detecting means for detecting a fault in an estimated magnetic pole position of said AC motor.